Section 3

Description of Proposed Action: Methods

This section describes the construction methods and maintenance activities that are covered under this Seattle Biological Evaluation. These activities are required to construct, maintain, repair, or replace City of Seattle facilities or improve or maintain operations to ensure public safety and the longevity of infrastructure.

The Seattle Biological Evaluation covers 14 methods the City of Seattle uses in performing construction projects and for maintenance activities:

1. Delineation of work areas and project startup
2. Clearing, grubbing, grading and placement of temporary fill
3. Temporary dewatering of an upland construction site
4. Work area isolation and fish removal in streams, large waterbodies and for pipe bypass
5. Pipe and culvert installation, replacement and maintenance
6. Vactoring, jetting, and excavating accumulated sediments
7. Bank stabilization
8. Habitat addition and maintenance
9. Trench safety/support systems
10. Beach nourishment and substrate addition
11. Boat launch improvement, repair and maintenance
12. In-water/overwater structure repair and replacement
13. Site restoration
14. Landscaping and planting.

Conservation measures are used in conjunction with these construction methods. Each required measure is listed for each method in this section. The conservation measures (CMs) are presented sequentially (CM# 1 through 75) and in detail in Section 4. See

Appendix A for the Conservation Measures (CM) checklist. It shows each method and its corresponding conservation measures.

3.1 Method 1: Delineation of Work Areas and Project Startup

Delineation of environmentally sensitive areas, project staging areas or other work areas is a common construction activity before project startup. This routine construction activity includes flagging, installing stormwater pollution prevention BMPs and other actions, as needed, to protect sensitive areas. Environmentally sensitive areas are identified and protected to keep people and equipment out of them (unless the project area lies within a sensitive area) and to limit the impact of construction activities on the site. Staging areas are used to secure materials and equipment. Identifying staging areas is necessary to initiate project site work. Other work areas may include temporary access roads or stream access points.

Some activities identified in this method may be more appropriate after completion of clearing, grubbing, or grading work (see **Method 2**).

A. Sensitive Areas

Before project start, environmentally sensitive areas are protected as appropriate. Environmentally sensitive areas include marine shorelines, lakes, streams, riparian corridors or wetlands and their buffers. These areas may be protected using flagging, fencing, wood pallets, mulch, or other appropriate method, which shall be maintained throughout construction. Project managers and/or designers are responsible for consulting with a professional expert in this field to determine environmentally sensitive areas as well as features that are regulated. Also it is prudent to understand that federal, state and/or local regulators may apply their jurisdiction differently for the same feature. So check with all regulatory agencies for jurisdictional determination.

B. Work Areas

Project startup includes delineating work areas where the following may occur:

- Access roads and access points (such as along a stream)
- Contractor administrative offices
- Earth, wood, plastic, concrete and metal products storage
- Fencing installed for security and/or to protect areas not to be disturbed
- Fuel and other potential pollutants storage
- Material delivery or removal or temporary storage
- Vehicle wash areas
- Vehicles, trailers and construction equipment, such as excavators, trucks, etc., storage, parking or servicing.

Delineation of these areas may include use of flagging, fencing, mulch, coir rolls, or other appropriate materials that must be maintained throughout construction.

C. Stormwater Pollution Prevention

Project startup also involves installation of stormwater pollution prevention measures. Among these measures are temporary erosion and sediment control measures (TESC), which are specified on a TESC plan. TESC measures are used to minimize erosion and offsite sediment transport that could damage environmentally sensitive areas and aquatic life. TESC measures must be maintained throughout construction.

Equipment Used

Bulldozer, car, excavator, tractor, fork-lift, hand tools, hydro-seeding truck, pick-up truck, portable storage facilities, tanks, trailer, water truck, wheelbarrow

Conservation Measures • Approved work windows • Stormwater pollution prevention	
#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project. (Std Spec 1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan. (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Minimize site- preparation-related impacts
5	Confine construction impacts to the minimum area necessary to complete the project and delineate impact areas on project plans. Flag boundaries of clearing limits associated with site access, construction, and staging areas as well as wetland and riparian corridor where work has been authorized.
6	Establish staging and site access areas along existing roadways or other disturbed areas to minimize erosion into or contamination of sensitive areas or their buffers. Confine work to the area noted using flagging or other barriers.
8	Divert run-off from entering the project (disturbed) area.

9	Ensure proper BMPs, such as covering, berming, matting, seeding, or mulching, are implemented to prevent erosion of any excavated material.
	Minimize earthmoving-related erosion
22	If equipment wash areas are required, they shall be located where washwater, sediment, and pollutants cannot enter waterbodies, including wetlands.
23	No sediment shall be tracked onto paved streets or roadways. Sediment shall be removed from trucks and equipment before leaving the site.

3.2 Method 2: Clearing, Grubbing, Grading and Placement of Temporary Fill

Clearing, grubbing, and grading are done to access staging areas and the project work site including the construction of temporary roads and to establish basic grades for project sites. Clearing is the removal (or pruning) of vegetation including trees. Grubbing is root and organic debris removal. Grading is moving earth with large equipment, generally to establish access or staging areas or to prepare sites for installation of structural elements and final site preparation.

If the City of Seattle's Environmentally Critical Areas Ordinance (SMC Chapter 25.09) thresholds for vegetation removal are reached, a plan to restore native vegetation will be prepared. See the DPD website: http://www.seattle.gov/dpd/Codes/default.asp#enviro.

When temporary fill is needed for access roads or work platforms, the preferred method should reduce impacts to sensitive and beach areas. Such methods include placing timber mats, pallets, or metal sheeting under the fill. If those methods are not feasible, hog fuel (wood waste), hay or other easily biodegradable material can be used and complete removal of those materials is not required.

When no low-impact alternative exists, temporary backfill for roadways and work platforms may be necessary to provide a stable surface in mucky or marshy areas. If imported soil or rock is used as temporary backfill, a geotextile separator is recommended to create a barrier between the existing soil and the fill material. Geotextile also helps to define the plane between the native material and the fill material to ease post-project fill removal.

Equipment Used

Backhoe/excavator, brush cutter, bulldozer, car, chain saw, dump truck, front-end loader, hand tools, hydro-seeding truck, pick-up truck, scraper, tractor, trailer, weed trimmer, wheelbarrow

Conservation Measures • Approved work windows • Stormwater pollution prevention • Pesticides	
#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Minimize site-preparation-related impacts
7	Limit clearing and grubbing area to minimum required. Retain vegetation to maximum extent possible. Minimize clearing and grubbing effects by cutting vegetative stems but not removing the root systems, which can help to reduce erosion potential and allow native plants to regenerate.
9	Ensure proper BMPs, such as covering, berming, matting, seeding, or mulching, are implemented to prevent erosion of any excavated material.
12	Place sediment barriers (e.g., silt fences, coir logs, wood straw or other effective erosion control method) around disturbed sites to prevent erosion from sediment deposition into a waterbody.
13	Keep a supply of erosion control materials (e.g., silt fence or mulch) on hand to respond to sediment emergencies. For wetland areas with high likelihood of germination, use wood straw.
14	Use curb inlet sediment traps, geotextile filters, along with silt fencing, to capture sediment before it leaves the site.
	Minimize earthmoving-related erosion
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.
20	Use temporary materials such as geotextile barriers, hog fuel or wood pellets to stabilize haul and access routes, staging areas and stockpile areas.
23	No sediment shall be tracked onto paved streets or roadways. Sediment shall be removed from trucks and equipment before leaving the site.
	Pesticides
72	Pesticides will be applied only under direct supervision (within line of sight) of a licensed applicator.
74	Within the shoreline and riparian zone of all waterbodies, use only herbicide products containing glyphosate for general weed control and/or selected Washington State Department of Ecology-approved herbicides mandated for aquatic noxious weed control.

3.3 Method 3: Temporary Dewatering of an Upland Construction Site

Temporary dewatering is the collection of surface and subsurface water encountered during construction excavation or related work. It includes the pre-approved and appropriate discharge and release to existing facilities or waterbodies. When an excavation intercepts groundwater or when stormwater accumulates after heavy rain in a depression, the inflow must be pumped out of an upland construction site. Sometimes dewatering is done to depressurize beneath an excavation, particularly if a low permeability soil layer lies near the bottom of the excavation. Failure to depressurize can cause the bottom of the excavation to heave.

Construction dewatering typically occurs by pumping from a sump or lowest point within an excavation if the excavation does not extend more than 4 feet deep. The Seattle Biological Evaluation **does not** cover any excavation deeper than 4 feet. Dewatering under the Seattle Biological Evaluation is limited to excavations 4 feet or less deep and not to exceed the duration of the construction. Permanent dewatering is not covered under this document.

Temporary dewatering can be done with or without a trench safety system. Temporary dewatering of an upland location requires determining the volume and rate of groundwater infiltration into excavation areas at the project site to determine the proper size for pumps and hoses. The City crew/contractor must provide capacity to account for stormwater flows and obtain a stamped recommendation from a geotechnical engineer when steep slopes are involved.

The following is general technique for temporary dewatering of an upland site:

1. In sites where the planned excavation is in soft, loose, or permeable soils, the dewatering system should be designed by an experienced person (WAC 286-155 part N). In addition, a registered professional engineer must design the dewatering system if it includes wells or well points, may require recharge wells or trenches, or is part of a trench safety system.
2. Use plastic sheets, geotextile fabric, concrete barriers, pumps or other methods appropriate to site conditions to divert stormwater or groundwater from entering the excavated pit (Std Spec 1-07.5(2).
3. Establish a sump at the intake or get a self-priming pump and adjust the pumping rate to ensure that the intake hose remains submerged.
4. Carefully select the dewatering discharge point to avoid the following complications: water re-entering the work area, erosion at the discharge point, and impacts to natural systems (Std Specs 1-07.5, 1 07.15, 7-21, and 8-01).
5. If using a trench safety system, require the City crew/contractor to incorporate dewatering and/or soil stabilization technique into their methodologies based on the project's geotechnical report.

6. Seattle Public Utilities staff must evaluate the dewatering plan before City crews/contractors implement the plan. Seattle Public Utilities staff will determine if pretreatment or flow control is needed to protect downstream systems.

Equipment Used

Backhoe/excavator, car, concrete mixer, concrete pump, drill rig, hand tools, hose, pick-up truck, piling and lagging, pump, sheet driving, trailer, wheelbarrow

Conservation Measures • Approved work windows • Stormwater pollution prevention	
#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
30	Develop a Temporary Dewatering Plan (TDP) for any dewatering lasting more than 1 day or requiring the installation of a trench safety program.

3.4 Method 4: Work Area Isolation and Fish Removal in Streams, Large Waterbodies and for Pipe Bypass

Dewatering work areas and fish removal are standard practices to minimize impacts to aquatic species. To reduce turbidity, construction areas that occur within natural drainage systems and shorelines or pipe infrastructure are isolated before and during project work to prevent scour and eliminate the creation of sediment. This method includes removing all fish from the isolated area using the fish handling and capture protocol described below under section *.C. Fish Removal and Handling*. Method 4 includes the following:

- **Temporary bypass for stream flow in a partial channel***:* Occurs when a full bypass is not required because work occurs in a limited area of a stream. This method requires fish removal before installation of the bypass.
- **Temporary bypass for stream flow in a full channel.** Occurs when a full bypass is required because work occurs within a full channel. This method requires that fish be removed before installation.
- **Isolating the work area in large waterbodies**. Typically, this method involves using a silt curtain to contain sediment.
- **Isolation/dewatering of piped infrastructure**. This method involves bypassing stormwater and combined sewers that discharge to a creek or other waterbody.

All work must occur in isolation from flowing waters except for the following:

- Install and remove stream isolation structures (coffer dams, bypass flow devices, pumps, and screens)
- Fish removal procedures
- Place wood and rock structures (that do not require in-water excavation).

For any bypass that will be in place for longer than **1 day**, a contingency plan must be developed to account for unexpected high flows.

In certain work situations, isolating and dewatering the construction site is not needed and could ultimately cause more disturbance than just working in the water. These situations would **not** involve any excavation within wetted areas and do include activities such as placing rock or wood structures. For this work, Method 4 is **not** required and should be noted as **not required** on the SPIF (See Appendix A).

A. Isolation of In-water Work Area

Typically, an in-water work area is isolated with a diversion structure that is a temporary dam consisting of sand bags filled with clean gravel and covered with plastic sheeting and built just upstream of the project site. A portable bladder dam or other non-erosive diversion technologies may be used to contain stream flow. Stream or floodplain rock and sediment cannot be used to construct a diversion dam. In most cases, a pipe carries the stream flow from the diversion dam around the project site to a location immediately downstream of the construction zone.

1. Temporary Bypass for Stream Flow: Partial Channel

Stream flow may be temporarily bypassed to one side of the existing channel by placing diversion structures around the work area to prevent any stream flow from entering the work area. Scour and the potential for transport of sediment should be minimized.

The following project conditions allow in-water rerouting:

- Stream channel that is wide enough to accommodate rerouting
- Diversion path that is essentially non-erosive
- Flows that support these methods.

The diversion path will be, but is not limited to, one side of the existing channel. Temporary bypass of this type is most often associated with project activities that reshape a bank, remove armoring below the OHW[1] line or add structure or channel substrate. Under this scenario, fish can pass freely up or downstream. However, fish within the isolated portion of the stream will need to be relocated. Care should be taken to protect killing fish by placing a diversion structure on them if they are hidden in the substrate.

2. Temporary Bypass for Stream Flow: Full Channel

In most cases, a gravity or pump system will bypass stream flow from an upstream containment berm or dam around the project site to a location immediately downstream of the construction zone. The length of the isolated stream channel can vary, depending on project size.

All projects will have a method to dissipate flow at the downstream end of the diversion. The following are examples of site-specific options for dissipating flow at the downstream end of the diversion (Std Spec 2-10):

- Ecology block ‘box’ filled with gravel and riprap with option to place on plastic sheet or geotextile

[1] Ordinary high water (OHW) The visible line on a bank where the presence and action of waters are so common as to leave a mark on soil or vegetation.

- Porous geotextile bags for water to seep out
- Flow spreaders that spread flow from a concentrated point source to a widespread sheet flow
- Visqueen sheets or geotextile fabric to protect the streambed within the discharge area to reduce the energy of the discharge
- 90-degree elbow on the end of the pipe with the water falling into a small pool created by using visqueen and straw bales.

It may be necessary to have temporary equipment access through the riparian area to the site of the dewatering structure.

3. Isolating Work Areas in Large Waterbodies

This section applies to isolating work areas **along the shoreline** in both marine and freshwater. In marine waters, isolation of the work area may be needed when construction cannot be completed during low tide. Isolation of areas in large waterbodies like Lake Washington or the Lake Washington Ship Canal may be needed to minimize construction related impacts to water quality and aquatic species. Work may include, but is not limited to, such activities as sediment removal or maintenance, repair, or installation of outfalls, pilings, bulkheads, or shoreline stabilization. Schedule the majority of work to occur in the dry not in water.

Isolation of work areas in large waterbodies may include the installation of a sediment or silt curtain around the outside perimeter of the work area. Dewatering a work area in a large waterbody may be necessary. Methods such as free standing steel support frames or ecology blocks and visqueen or plastic have been successful in dewatering work areas.

B. Isolation/Bypassing of Piped Infrastructure

This method applies only to Seattle Public Utilities stormwater and combined sewers that discharge to a creek or other waterbody. It includes any bypass within a 0.25 mile of a creek discharge point and outfalls into waterbodies that may extend some distance into the water body.

Bypassing around piped infrastructure is necessary to isolate the pipe from the flow so that the pipe or culvert is accessible for maintenance or repair. Bypassing reduces turbidity, prevents scour, and eliminates sediment transport. Set the bypass at the most convenient upstream maintenance hole. Determine the maximum flow possible in the pipe to determine pump size and pumping rates. Pumping can create a head in the maintenance hole where the pump is located. Determine the maximum head allowable for the size of bypass system to prevent flooding. The following conditions can occur (Std Spec 7-17.3(2)K):

- If backwater from the pumped flows impacts the upstream system, flows may be pumped to the nearest downstream maintenance hole. Stormwater should be pumped to a stormwater maintenance hole and combined sewer should be

pumped to a combined sewer maintenance hole. If laterals are connected to the mainlines being maintained or repaired, similar bypass procedures should be implemented

- The bypass system should account for specific backwater conditions. If it is possible that potential rain events could create flows greater than the design bypass system, provisions for high-water bypass should be made.
- For stormwater systems, if no maintenance hole is available, flows may be pumped to the receiving stream if it meets state water quality standards. For combined sewers, provisions need to be made to discharge flows to the combined mainline located downstream of the maintenance or repair.
- If treatment is required, the flow may be pumped to a tank for settling. Onsite infiltration and dispersion is possible if conditions permit. Re-introduction back into the stream is an option once the water meets State Water Quality Standards. The project manager will need to show some sort of evidence that this will work.
- If the discharge exceeds the capacity of a nearby stream, the flows may be pumped to a tank or truck for offsite disposal.

C. Fish Removal and Handling

Before dewatering a stream section or beginning construction in an isolated work area in a large waterbody, fish must be removed.

1. Streams

The sequence for stream flow diversion and fish capture is shown on Table 3-1. Block nets are placed upstream and downstream from the work area to prevent fish from entering the stream segment to be dewatered. City crew/contractors will install block nets, capture and relocate all fish, divert streamflow around the project area, then remove the block nets all in the same day. On rare occasions, block nets may remain in the stream overnight when the fish capture and diversion activities require additional time to complete. Once the project area has been isolated with block nets, fish will be captured and relocated outside of the work area.

Table 3-1
Stream flow diversion technique

	Method
1	Install fish block nets above and below project.
2	Conduct initial fish removal procedure. This may include seining and electrofishing. Remove as many fish as possible at this time.
3	Install flow conveyance devices (pumps, discharge lines, gravity drain lines, conduits, and channels) directly below the fish block nets, but do not divert flow. Suction devices should be outfitted with a fine mesh screen in addition to the factory screen.
4	Install upstream diversion dam in stages allowing water to dissipate from the downstream area in a controlled orderly fashion. This can be assisted by manipulating the pump if the unit rented for the project is self-priming. During this process, fish relocation in the downstream section should continue.
5	Coordinate stream flow reduction with fish relocation so the bypass is not fully installed until the fish relocation protocol has been completed.
6	Install downstream diversion dam if necessary (only in low gradient, backwatered reaches). Installation of downstream diversion may be required earlier (during step 4) to facilitate complete dewatering of stream section.

2. Large Waterbodies

Isolation and fish removal of a work area in a large waterbody should be conducted in a manner best suited to the proposed project. Different alternatives may be used to remove fish from the work area. The following are 2 methods that may be used.

1. Isolate the work area by installing a barrier such as a sediment or silt curtain around the perimeter of the work area. Fish inside the enclosure can be removed by seining or pulling a large net through the work area. Multiple passes may be needed to ensure removal of all fish.
2. Exclude fish within the work area during installation of the sediment or silt curtain. This method involves expanding the work area from a central location. The work area remains fish free as the sediment or silt curtain is installed. A seine or large net may be needed to exclude fish during installation because sediment or silt curtains do not easily allow water through the curtain. A weighted net can be easily moved through the water to exclude fish while the sediment or silt curtain is installed.

For either alternative, the work area should be checked by divers to verify that fish are removed before work begins. Additional alternatives may be used but a complete description on how fish will be removed or isolated will be needed.

If a work area in a large waterbody must be dewatered (usually near shore), the sequence for fish removal and dewatering should be followed like that described above for streams.

D. Rewatering Work Area

The following is general practice for rewatering an instream or large waterbody work area or piped infrastructure:

1. Remove diversion dam and temporary bypass equipment. This activity may have to occur slowly, in a stepwise fashion to ensure rewatering the construction site occurs at a rate that prevents:
    - Loss of surface water downstream as the site streambed absorbs water
    - Sudden increase in stream turbidity
    - Scour
    - Damage to newly installed improvement.
2. Heavy machinery (operating from the bank) may be used to aid in removal of diversion structures. Use of the machinery may require a TESC-prepared access path. Look downstream during rewatering to prevent stranding aquatic organisms below the construction site.

Equipment Used

Backhoe/excavator, car, chain saw, cofferdam, diversion dam materials, dump truck. pick-up truck, pump, hoses, trailer, weed trimmer, wheelbarrow.

Conservation Measures

- Work area isolation
- Fish handling

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	Work Area Isolation
31	Follow proper work area isolation measures (see Table 4-4 in Section 4).
	Fish Handling
32	Follow proper fish capture and handing measures (see Tables 4-5 through 4-7 in Section 4)

3.5 Method 5: Pipe and Culvert Installation, Replacement and Maintenance

Pipes include those for conveyance of drinking water, as well as for stormwater and sewage wastewater. Pipe and culvert installation, replacement and maintenance include the following.

- Removal and replacement of pipes, culverts and outfalls
- Removal of material that blocks or restricts flows in and around pipes, culverts and outfalls
- Correction of structural deficiencies that affect pipe, culvert and outfall integrity

Replacement or maintenance of pipes and culverts often requires a bypass of any water in the project area. There are 2 types of bypass systems, depending on location:

1. For culvert or outfall installation, replacement or maintenance work in a stream or large waterbody, refer to **Method 4,** Work Area Isolation and Fish Removal in Streams, Large Waterbodies and for Pipe Bypass.
2. For installation, replacement and maintenance of pipes and culverts, refer to Pipe and Culvert Cleaning, Repair and Installation, below.

Additional methods that may be applicable include **Methods 6, 9 and 10**.

Over time, accumulated sediment or other blockages (e.g., roots) restrict flow capacity and reduce the performance of the system. Overflows or backups can decrease water quality if they reach surface waterbodies. If not repaired, structural deficiencies can threaten pipe and culvert integrity and could significantly impact roads, buildings, infrastructure and groundwater and surface water quality. They can also induce piping of surrounding soils, causing turbidity, local subsidence, and downstream flow blockages. Pipes and culverts serving drainage, sanitary sewer, and potable water systems are currently inspected and maintained on an as-needed basis. The frequency of inspection and maintenance depends on the type, age and condition of the pipe and its proximity to trees, structures, or facilities, and the risk incurred if it is not maintained.

Pipe inspection generally includes the use of closed-circuit cameras to identify blockages, sags, root intrusion or pipe damages, such as cracks, holes and separated joints (Std Spec 7-17.3(4)I).

- If blockages are due to sediment or other material, maintain the pipe by vactoring out the blockage to a vactor truck and transporting it to a vactor pit. If high-pressure jets are required to remove the debris from the pipe wall, then a temporary barrier may be installed to contain the washed sediment or debris before it is vactored out.

- If blockages are due to root intrusion, hydro-cut. Chemical treatment may be done in sewer pipes, where no chemicals would enter any surface waterbody, directly or indirectly.
- If repairs or installations are required, excavate and replace the section of the pipe or culvert, excavate for spot repair work, or use a trenchless technology (e.g. cured-in-place pipe or liner) where feasible to reline or repair the deficiency. In some cases, spot repair work or trenchless technologies will not be feasible, in which case the pipe or culvert must be replaced. Where a pipe or culvert is replaced or spot repair work performed, properly bed and fill the excavation. When replacing outfalls along shorelines, special methods must be used to minimize aquatic impacts, such as constructing temporary berms. Consider whether work will be done above water, in-water, or in the dry.

Equipment Used

Backhoe/excavator, compressor, dump truck, equipment/vehicles used for relining, front-end loader, hand tools, jetting/root cutter truck, pump, hoses, tractor**,** TV inspection equipment, vactor truck, wheelbarrow. Especially for outfalls, barges, cranes, equipment to install sheets and piles, boats, concrete trucks and pumpers, and silt curtains.

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Pesticides

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec 1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.

	Minimize sit- preparation-related impacts
12	Place sediment barriers (e.g., silt fences, coir logs, wood straw or other effective erosion control method) around disturbed sites to prevent erosion from sediment deposition from entering a waterbody.
13	Keep a supply of erosion control materials (e.g., silt fence or mulch) on hand to respond to sediment emergencies. For wetland areas with high likelihood of germination, use wood straw.
14	Use curb inlet sediment traps and geotextile filters, along with silt fencing, to capture sediment before it leaves the site.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
17	Two oil absorbing floating booms appropriate for the size of the work shall be available onsite during all phases of work whenever heavy equipment is used below the OHW or MHHW. The boom shall be placed in a location that facilitates an immediate response to potential petroleum leakage.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Temporary Dewatering Plan requirements
30	Develop a Temporary Dewatering Plan (TDP) for any dewatering lasting more than 1 day or requiring the installation of a trench safety system.
	Pesticides
75	Other chemicals, such as foaming agents used to kill roots growing into utility pipes, will be subject to Tier 1 chemical applications that will require approval from the Parks IMP coordinator and the Office of Sustainability and Environment.

3.6 Method 6: Vactoring, Jetting, and Excavating Accumulated Sediments

Removal of accumulated sediments in drainage systems, creek systems, around outfalls and along shorelines may be necessary to prevent flooding problems and maintain access for both fish and boats. Sediment removal and discharge of fill is either the removal or the addition of material (typically earth) that results in lower or higher elevations. Activities under this method include vactoring, jetting and excavating accumulated sediment.[2] Excavation is necessary to provide access to existing facilities or to install new infrastructure and to maintain facilities specifically designed for stormwater quality. Sediment is removed to allow structures to function as designed by removing blockages and accumulated sediment.

A. Vactoring and Jetting

Vactoring is removal of sediment and turbid water using vactor trucks with suction hoses. Jet cleaning (jetting water into a culvert) is occasionally required to loosen sediment in a pipe or culvert. Typically, material is flushed down to a catchbasin or sump where it can be captured and vactored out. Vehicles are staged adjacent to the work area, typically in an upland area. Vactored material is stored in trucks and disposed of at one of the City's vactor waste facilities.

B. In-Water Excavating

This method is used to remove accumulated sediments from boat ramps/launches, near floats or docks, around culverts or outfalls, and within creek channels, in-line/off-line sedimentation pond, fish ladders, or restoration areas. Excavation removes accumulated sediment below the MHHW[3] line that interferes with navigation or boat movement or below the OHW line that impedes conveyance. Bank and shoreline stabilization may require excavation as part of repairs.

As sediments accumulate on and adjacent to boat launches, culverts, outfalls, or other structures, these sediments are periodically removed (Table 3-2). Work is typically done when the water level is low to minimize the amount of work required within the wetted perimeter. Equipment is hauled or driven onto the ramp using existing roadways. For work that occurs in the dry, a tractor or backhoe is operated directly from the launch. Sediments are excavated and hauled to an upland disposal site. If work in the wetted perimeter is necessary, sediments are removed with hand tools or, if mechanized equipment is used, only an extension arm and bucket operate in the water. If the

[2] The Corps' defines 'dredging' as the removal of sediment to facilitate navigation. The City does not remove sediment for navigational purposes. All other sediment removal from waters of the United States would be considered 'excavation.'
[3] Mean higher high water (MHHW) is a tidal (marine water) datum that is the average high water height.

extension arm is not able to reach the accumulated sediments, a barge-operated excavator may be used.

Table 3-2
Limits for material removal on separate projects

Type of project	Limit
Boat launch or small craft center	50 cubic yards
Shoreline restoration, float or dock	up to 25 cubic yards
Bank stabilization project	up to 30 cubic yards

Equipment Used
Backhoe/excavator, boat/barge combinations, car, concrete trucks and pumpers, crane, dump truck, equipment to install sheets and piles, hand tools, rake, silt curtain, pickup truck, pumps for by passing flows, tractor, trailer, vactor truck, wheelbarrow.

Conservation Measures
- Approved work windows
- Stormwater pollution prevention
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec 1.07, 1.5, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5) .
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.

	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
17	Two oil absorbing floating booms appropriate for the size of the work shall be available onsite during all phases of work whenever heavy equipment is used below the OHW or MHHW. The booms shall be placed in a location that facilitates an immediate response to potential petroleum leakage.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Minimize earthmoving-related erosion
21	Stockpile native streambed or substrate materials above the OHW for later use in project restoration. To prevent contamination from fine soils, these materials shall be kept separate from other stockpiled material not native to streambed or substrate.
	Minimize stream crossing sedimentation
25	Minimize stream and riparian crossings. If possible, cross at right angles to the main channel.
26	Where temporary stream crossings are essential, crossings shall be managed to minimize the risk of creating erosion.
	General restoration in open waters
27	For in-water work at or below OHW or MHHW, appropriate and effective erosion control devices or other water quality control devices will be in place before project work begins. Control devices include sealed sand or gravel bags, silt curtains, silt fencing or other containment systems. Deploy and maintain curtain at sufficient depth to reach bottom and contain sediment
28	If mechanized equipment is used within the OHW or MHHW, only an extension arm with bucket or similar attachment shall enter the water. Conduct debris removal and work below OHW or MHHW during low water levels (fresh waters) or at low tide (marine waters). This prevents material from entering the water during construction. All debris removed shall be disposed of offsite in an approved upland disposal area.
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
54	Perform all work in the dry whenever possible (80-90% of the time)
55	Minimize construction impacts by conducting work during minus tides or low water levels.
57	To avoid entraining fish, an excavated trench exposed to open water between tidal cycles should be sloped or filled with sand and gravel to optimize fish habitat.
58	Equipment and materials are mobilized to and from the site via upland access or construction barge. If the project area is not isolated and dewatered, a silt curtain will be installed.
59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

3.7 Method 7: Bank Stabilization

This method is the demolition or replacement and repair of existing banks, construction of new bank stabilization, and placement of toe/logs in various waterbodies Stabilization measures are structural remedies to arrest eroded or slumped streambanks or marine shorelines. Banks and shorelines need stabilization when projects call for removing, repairing, or maintaining fixed structures. Bank stabilization may also be needed in areas of high slope erosion. Stabilizing disturbed or unstable water edges eliminates upland erosion deposition of sediment into a waterbody. It also minimizes the risk of failure of adjacent roadways, utilities, or other public facilities. Bank stabilization is used to improve existing structures, to enhance habitat for juvenile salmonids, to prevent erosion and scour, and to minimize the risk of failure of adjacent roadways, utilities or other public facilities. Bank stabilization includes these activities:

- Demolition of bulkheads, revetments and groins
- Construction of sheet piling bulkhead
- Construction of cast-in-place concrete bulkheads
- Construction of log or rock toes
- Biotechnical stabilization
- Repair of bulkheads.

The shoreline or streambank will typically be graded with at least a 2H:1V slope or shallower. See WDFW *Integrated Streambank Protection Guidelines* for methods (WDFW 2003). If none of the methods listed below provide adequate stabilization to the slope, it may be necessary to install rock facing or retaining walls.

A. Demolish Bulkheads, Revetments or Groins

Bulkheads are retaining walls along a waterfront. Revetment is the term for a facing (either stone or concrete) to sustain an embankment. A groin is a rigid structure built out from shore to protect the shore from erosion, to trap sand, or to direct a current. These structures can be found in several City parks.

Where possible, utilities are relocated from the work area. The bank stabilization and fill material behind it are removed by a variety of equipment types including, but not limited to, an upland-based excavator, trackhoe, bulldozer and/or barge mounted crane. The excavated material is exported to an established stockpile area for disposal or reuse depending on the needs of the project. For sheet pile bulkheads, if piling cannot be fully extracted, they are cut at or below (2 feet) the mudline and dismantled.

B. Construct Sheet Piling Bulkhead

Where a new bulkhead will be replaced, a toe is excavated to the required depth. The excavated material is exported to the established stockpile area for later transport to an approved upland disposal site. In some cases typically involving deeper sheet piling installation, sheet piling may be driven using vibratory hammers. In other cases, auger cast piling may be driven by impact hammer or vibratory hammer and sheet piling, concrete panels, or heavy timber aging installed to create the wall. If necessary, tie-backs are installed at intervals along the sheet piling and attached to deadman anchors located landward of the structure. If necessary, aggregate backfill and drainage piping may be installed to relieve hydrostatic pressures behind such walls. Structural backfill and a drainage system are placed behind the sheet piling. Clean gravel is then placed in the excavated toe along the waterward face of the sheet piling. If necessary to buttress the sheet pile wall or reduce its vertical height, riprap shoreline protection is placed in front of the wall. This armoring includes a toe at the waterward edge and a topping of gravel (habitat mix) to fill in the interstitial spaces.

C. Construct Cast-in-place Concrete Bulkhead

A footing area is excavated to a sufficient depth to prevent undercutting of the new bulkhead. The excavated material is exported to the established stockpile area for later transport to an approved upland disposal site. Reinforcing bars and forms for the footings and walls are constructed and the forms are sealed. For tidal waters, concrete is poured into the forms when the tide is out. Once the concrete is cured, the forms are removed. The drainage system is installed for the following:

- Weep holes built into the bulkhead. The landward face of the bulkhead is lined with filter fabric and the area within ~ 18 inches of the wall is backfilled with a clean, free-draining sand and gravel
- Lateral drainage system. A perforated pipe surrounded by a layer of drain gravel and wrapped in filter fabric is located and sloped to a suitable discharge area.

Filter fabric is laid on the excavated soil and structural backfill is placed and compacted. If necessary, substrate material (e.g., fish habitat mix) is placed waterward of the bulkhead.

D. Construct Log or Rock Toe

Toe protection treatments are generally constructed in conjunction with upper-bank treatments such as woody vegetation planting (see below *section E, Biotechnical Stabilization*). The toe and anchor points are excavated to the maximum calculated depth of scour. Logs and/or rocks are installed and anchored in the toe. The top elevation of the toe generally reaches the lower level of bank vegetation (OHW). Voids in the toe, depending on the size, are filled with rock and gravel. Root wads, large woody debris, and live staking can be incorporated into the toe design.

The bank is excavated to prepare the subgrade to a smooth slope no more than 1H to 1.5V, and preferably flatter, such as 2H to 1V. Any debris or deleterious materials are removed as part of the work. A bedding layer of crushed rock, typically 2-1/2 inch minus or 4-6 inch minus is installed to cover all of the exposed soils. Large, heavy toe rock (using fractured two-man or three-man rock), depending on the site, is then installed at the lower end of the slope to create a toe. Several layers of larger rock are then installed above the toe rock and on top of the bedding layer. These layers may be in the form of light, loose riprap or several layers of light riprap covered by heavy riprap to armor the underlying layers. The outer layer should be set as tightly as possible to minimize void spaces between the rock and to seal these inner layers. The overall effect is to create a flexible revetment of rock that will harden an exposed bank. All rock is typically placed by track excavator, reaching the work area from atop the bank. In some situations, work may need to be done from a barge mounted excavator. Habitat mix is needed to fill interstitial spaces.

E. Biotechnical Stabilization[4]

As necessary, the shoreline is graded to a stable, and if possible, gentler slope and excavated for placement of biotechnical (biodegradable) components and/or internal subsurface drainage components (e.g., gravel seams, collection drains, etc.). The excavated material is exported to the established stockpile area for later transport to an approved upland disposal site. If native soil (bank soil), is used in backfilling soil wraps/other structures, it need not be removed from the site. Typical biotechnical stabilization techniques include herbaceous cover, native woody vegetation (e.g., willow live stakes, cottonwood poles, containerized plants, bare-root stock, salvaged plants, etc.), brush layering, fascines, brush matting, coir blankets, reinforced soil lifts and coir logs. Depending on the cause of erosion and geotechnical considerations, these techniques are used alone, in combination with other biotechnical approaches, or in combination with structural toe protection (see section D, Construct Log and Rock Toe, above). Design and installation guidelines for these techniques are provided in Chapter 6 of the *Integrated Streambank Protection Guidelines* (WDFW et al 2003).

[4] *Biotechnical stabilization* as defined in this document is a stabilization method consisting entirely of biodegradable components (e.g., natural erosion control fabric, large woody debris, native vegetation, brush mats). This definition is taken from the *Integrated Streambank Protection Guidelines* WDFW et al 2003.

F. Repair Bulkheads

Several methods are available to repair damage to a bulkhead with and without the need for removal and replacement.

Replacing Eroded Substrate

If the toe of a bulkhead is exposed or undermined, the eroded area is filled with new material, typically clean sand and/or gravel to optimize habitat. The replacement material is placed and spread in the affected area by an excavator operated from the uplands or barge-based crane.

Facing a Concrete or Timber Bulkhead with Riprap

New riprap is placed in front of a bulkhead that is eroding at the base and/or from behind. The clean riprap is placed in the affected area by an excavator operated from the uplands or barge-based crane. To optimize habitat, voids may be filled with new rock, riprap, spalls, and clean sand and gravel

Resetting and/or Replacing Rock, Riprap, and Spalls

If rock material has been displaced from a bulkhead or the rock material has settled, the displaced material is reset and, if necessary, new clean material is placed into the bulkhead. The displaced rocks are grabbed by excavator or crane and repositioned into voids in the bulkhead. The heavy equipment is either operated from the barge or from uplands. To optimize habitat, voids may be filled with new rock, riprap, spalls, and clean sand and gravel.

Replacing Broken Sections of Concrete Bulkhead

The broken concrete pieces and soil behind the affected area are excavated as necessary. The excavated material is exported to an established stockpile area for later disposal at an approved facility. The broken edge of the bulkhead is smoothed/cleaned with a power wash, steel bars are embedded in the bulkhead (if the original bars are damaged or destroyed), a form is built and sealed, and the form is filled with fast-curing concrete. The form is left in place until the concrete is fully cured. Filter fabric is placed in the excavated area behind the bulkhead, and the area is backfilled with clean crushed rock.

Repairing Cantilever Soldier (Parallel) Piling on Landward Face of Bulkhead

The area behind the bulkhead is excavated by open cuts, shoring, and/or casing. The excavated material is exported to an established stockpile area for later disposal at an approved facility. Holes are drilled, casing is placed, H-beams are positioned into the holes, and the holes are backfilled with concrete. If necessary, additional drainage is

provided by installing new drainage holes or a new lateral perforated drain pipe sloped to a suitable discharge location. Filter fabric is placed along the landward face of a bulkhead with weep holes and/or around the lateral drain system. After the concrete backfill around the soldier piling is cured, free-draining structural backfill is placed behind the wall and compacted.

Equipment Used

Backhoe/excavator, cars, chain saw, concrete mixer, concrete pump, crane, drilling rig, dump truck, front-end loader, hand tools, hydro-seeding truck, pick-up truck, piling and lagging, sheet driving, tractor, trailer, weed trimmer, wheelbarrow

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Piling installation and noise abatement
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec 1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Minimize sit- preparation-related impacts
9	Ensure proper BMPs, such as covering, berming, matting, seeding, or mulching, are implemented to prevent erosion of any excavated material.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.

16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
17	Two oil absorbing floating booms appropriate for the size of the work shall be available onsite during all phases of work whenever heavy equipment is used below the OHW or MHHW. The booms shall be placed in a location that facilitates an immediate response to potential petroleum leakage.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	General restoration in open waters
27	For in-water work at or below OHW or MHHW, appropriate and effective erosion control devices or other water quality control devices will be in place before project work begins. Control devices include sealed sand or gravel bags, silt curtains, silt fencing or other containment systems. Deploy and maintain curtain at sufficient depth to reach bottom and contain sediment
28	If mechanized equipment is used within the OHW or MHHW, only an extension arm with bucket or similar attachment shall enter the water. Conduct debris removal and work below OHW or MHHW during low water levels (fresh waters) or at low tide (marine waters). This prevents material from entering the water during construction. All debris removed shall be disposed of offsite in an approved upland disposal area.
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Piling Installation and Noise Abatement
	Installation
43	Plastic, cement or timber piling is preferred over steel piling.
44	Use a containment boom for sawdust and debris work. If in marine water, a containment boom may rest on substrate rather than float at all times due to tidal action. Remove contained debris to prevent it from entering the waterway at construction completion.
45	If treated piling are fully extracted or cut below the mudline, cap the holes or piling with appropriate materials (e.g., clean sand or steel pile caps for cut piling). This practice ensures that chemicals from the existing piling do not leach into the adjacent sediments or water column.
46	Do **not** use piling treated with creosote or pentachloraphenol.
47	Do **not** use hydraulic water jets to remove or place piling.
48	Replace piling in same general location. Do **not** extend beyond footprint of existing structure.
	Noise abatement
49	Use a vibratory driver to the extent possible for setting piling. Geotechnical engineering can determine if this will be sufficient based on the piling material and load capacity.
50	A bubble curtain or other noise attenuation method (e.g., wood blocks, nylon blocks etc.) shall be used during impact installation or proofing of steel piling. For piling with a 10-inch or smaller diameter, the sound attenuation device must include one of the methods listed above. For piling with a diameter greater than 10 inches, the sound attenuation device must include both the placement of a sound bock between the hammer and the piling during pile driving **and** use of a bubble curtain.
51	Hydroacoustic monitoring shall be used for driving large (>12-inch diameter) steel piling.
52	All reasonable measures shall be taken for the suppression of noise resulting from the work operations. All work shall be performed consistent with the applicable noise

	control levels set forth in SMC Chapter 25.08 and comply with Std Spec 1-97.5(4) Noise Pollution.

	Shoreline and Aquatic Habitat Protection
	All projects/all structures
54	Perform the work in the dry whenever possible (80-90% of the time).
55	Minimize construction impacts by conducting work during minus tides or low water levels.
56	All fill materials will be of clean, washed, and commercially-obtained material.
59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
60	Take care to prevent spread of invasive plant species during their removal.
61	Plant the project shoreline with native riparian vegetation. City crew/contractor will ensure 80% survival of the planted material at 1, 3, and 5 years after installation. Riparian planting plans will be submitted along with the project permit application.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.
	Beach nourishment/substrate addition
64	Use clean gravel (less than 3% fines by weight [material passing a number 200 sieve per U.S. standard sieve size]) to avoid turbidity during gravel placement.
	Boat launch
66	No wet concrete or epoxy shall be placed in the wetted perimeter. Concrete and epoxy must be cured before they come into contact with the water.
	Bulkhead repair/replacement
67	Move the bulkhead as far back as possible above OHW or MHHW.
68	Construct bulkhead to contain habitat complexity, such as coves, where recreational use allows.
69	Plant new bulkhead with native riparian vegetation where not in conflict with recreational use.
	Riprap addition
70	When installing riprap, include rootwads and/or large woody debris to increase habitat complexity.
71	Cover all newly placed riprap with habitat mix to fill voids and cover the rock to benefit benthic organisms. In locations where habitat mix will wash away rapidly, it may be deemed unnecessary to install.

3.8 Method 8: Habitat Addition or Maintenance

Habitat elements are organic or inorganic objects that—when placed in or near aquatic areas—increase fish and wildlife habitat and protect infrastructure. Habitat elements include large wood, root wad, baffles, boulders, rock, and weirs. When placed into waterbodies, these objects can slow or alter flow directions and provide complex habitat including riffles, pools and appropriate substrate that create food and hiding places for fish and wildlife. Habitat addition and maintenance also protect infrastructure and sewer lines.

Habitat addition or maintenance work in the Seattle can require using heavy and light equipment and hand labor or a combination of these methods. Many projects including those in parks require establishing a temporary construction access. The following is the construction technique for habitat addition or maintenance:

- Select design and installation of habitat elements in accordance with the WDFW *Integrated Streambank Protection Guidelines* (WDFW et al. 2003).
- Instream or floodplain restoration materials (e.g. large wood and boulders) shall mimic as much as possible those found in a natural environment. Such materials may be salvaged or reused from the project site or hauled in from offsite but cannot be taken from streams, wetlands, or other sensitive areas.

Various anchoring techniques are sometimes required to prevent the movement of structures when their movement could damage downstream infrastructure or channel integrity. If anchoring is required, bury the habitat element—such as woody debris or boulders—into the banks. Use cable or concrete blocks only sparingly in project design and only when conditions do not exist to anchor woody debris naturally between riparian trees or into the banks. Use concrete sparingly when necessary to anchor boulders to concrete weirs to create a more natural effect (Std Spec 2-10).

A. Large Woody Material[5]

Large wood includes whole trees with rootwads and limbs attached, pieces of trees with or without rootwads and limbs, and cut logs. This material is used to change flow direction, provide grade control, reduce erosion at toe of bank, and provide habitat elements. Large woody material creates hydraulic diversity when installed in contact with water over a range of flows.

The design of these structures will follow guidance provided in WDFW *Stream Habitat Restoration Guidelines* (WDFW 2004). In general, coniferous tree species are preferred for this use. Deciduous species may be incorporated with coniferous species.

[5] Large woody material is also referred to as large woody debris or LWD in this document.

The most common method for anchoring large wood is bole burial and ballasting. Other methods include entanglement and/or bracing with other material such as rock or existing wood in stream or on the streambank. In some cases, logs may be pinned together using wood or rebar pins to increase structure stability.

This material can be installed using either hand or machine methods. Hand methods are generally limited to bracing, entanglement, and ballasting with other material. Burial or pushing this material into the banks by hand is limited. Machine installation methods include entanglement, bracing, trenching, digging, installing mechanical anchor, and pushing into the streambed and/or bank.

See below *E, Biotechnical Stabilization,* for a description of biotechnical techniques that use vegetation and wood to reproduce the natural system and to provide structural and surface erosion protection.

B. Boulders or Boulder Clusters

Placement of boulders and boulder clusters within the stream channel creates a diversity of water depth, substrate, and velocity. These placements are used to change flow direction, provide grade control, reduce erosion at the toe of bank, and provide habitat elements.

Methods and design will follow guidance provided in *WDFW Stream Habitat Restoration Guidelines* (2004). Boulders and boulder clusters can be installed by hand and/or machine. This material is installed by direct placement on the streambed, digging and placing in and/or along the toe and face of streambank. Rock can occur as the sole element (e.g., bank protection, weir or groin) or in conjunction with other materials (e.g., large woody material)

C. Weirs or Groins

Low-elevation weirs usually span the entire width of the channel. These structures are used to spill and direct flow away from an eroding bank, dissipate and redistribute energy, and provide grade control stabilization. Other applications may include flow realignment, fish passage, or increased habitat diversity.

Groins are used to realign a channel or redirect flow away from a streambank to protect it from erosion. Groins can also be used to increase flow resistance at channel locations that lack resistance elements.

Both weirs and groins are typically constructed with rock and/or large woody material. Weirs have also been constructed using sheet piling and concrete. Groins can also be constructed using pilings that collect other woody debris. The design of these structures will follow guidance provided in the *Integrated Streambank Protection Guidelines* (WDFW et al. 2003).

Equipment Used

Backhoe/excavator, boat/barge combinations, bobcat, bull dozer, car, chain saw, concrete mixer, concrete pump, dump truck, front-end loader, hand tools, hydro-seeding truck, large and small compactor, pick-up truck, tractor, trailer, weed trimmer, wheelbarrow

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Shoreline and aquatic habitat protection
- Pesticides

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (std Spec 1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan. (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Minimize site-preparation-related impacts
5	Confine construction impacts to the minimum area necessary to complete the project and delineate impact areas on project plans. Flag boundaries of clearing limits associated with site access, construction, and staging areas as well as wetland and riparian corridor where work has been authorized.
6	Establish staging and site access areas along existing roadways or other disturbed areas to minimize erosion into or contamination of sensitive areas or their buffers. Confine work to the area noted using flagging or other barriers.
7	Limit clearing and grubbing area to minimum required. Retain vegetation to maximum extent possible. Minimize clearing and grubbing effects by cutting vegetative stems but not removing the root systems, which help to reduce erosion potential and allow native plants to regenerate.
9	Ensure proper BMPs, such as covering, berming, matting, seeding, or mulching, are implemented to prevent erosion of any excavated material.
10	Stockpile large wood, trees, riparian vegetation, other vegetation, sand, and topsoil removed for establishment of staging area and reuse for site restoration.
11	Salvaged debris such as roots and stumps may be used for habitat. Disposal of debris may include chipping, shredding, or grinding for reintroduction to the site as mulch. (Std Specs 1-06.13(3), 1-07.5, 2-01.2, 2-10.3(2) and 8-01.
12	Place sediment barriers (e.g., silt fences, coir logs, wood straw or other effective erosion

	control method) around disturbed sites to prevent erosion from sediment deposition from entering a waterbody.
13	Keep a supply of erosion control materials (e.g., silt fence or mulch) on hand to respond to sediment emergencies. For wetland areas with high likelihood of germination, use wood straw.
14	Use curb inlet sediment traps and geotextile filters, along with silt fencing, to capture sediment before it leaves the site.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
17	Two oil absorbing floating booms appropriate for the size of the work shall be available onsite during all phases of work whenever heavy equipment is used below the OHW or MHHW. The booms shall be placed in a location that facilitates an immediate response to potential petroleum leakage.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Minimize earthmoving-related erosion
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.
20	Use temporary materials such as geotextile barriers, hog fuel or wood pellets to stabilize haul and access routes, staging areas and stockpile areas.
21	Stockpile native streambed or substrate materials above the OHW for later use in project restoration. To prevent contamination from fine soils, these materials shall be kept separate from other stockpiled material not native to streambed or substrate.
22	If equipment wash areas are required, they shall be located where washwater, sediment, and pollutants cannot enter waterbodies, including wetlands.
	Minimize stream crossing sedimentation
25	Minimize stream and riparian crossings. If possible, cross at right angles to the main channel.
26	Where temporary stream crossings are essential, crossings shall be managed to minimize the risk of creating erosion.
	General restoration in open waters
28	If mechanized equipment is used within the OHW or MHHW, only an extension arm with bucket or similar attachment shall enter the water. Conduct debris removal and work below OHW or MHHW during low water levels (fresh waters) or at low tide (marine waters). This prevents material from entering the water during construction. All debris removed shall be disposed of offsite in an approved upland disposal area.
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Temporary Dewatering Plan requirements
30	Develop a Temporary Dewatering Plan (TDP) for any dewatering lasting more than 1 day or requiring the installation of a trench safety system.

	Shoreline and Aquatic Habitat Protection
	All projects / all structures
54	Perform the work in the dry whenever possible (80 – 90%).
55	Minimize construction impacts by conducting work during minus tides or low water levels.
56	All fill materials will be of clean, washed, and commercially-obtained material.
57	To avoid entraining fish, an excavated trench exposed to open water between tidal cycles should be sloped or filled with sand and gravel to optimize fish habitat.
58	Equipment and materials are mobilized to and from the site via upland access or construction barge. If the project area is not isolated and dewatered, a silt curtain will be installed.
59	If a construction barge is used, it shall not ground or rest on substrate at anytime or anchor over vegetated shallows.
60	Take care to prevent spread of invasive plant species during their removal.
61	Plant the project shoreline with native riparian vegetation. City crew/contractor will ensure 80% survival of the planted material at 1, 3, and 5 years after installation. Riparian planting plans will be submitted along with the project permit application.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.
	Boat launch
65	Place appropriate habitat gravel mix as needed. The mix shall meet WDFW Hydraulic Permit Application requirements.
66	No wet concrete or epoxy shall be placed in the wetted perimeter. Concrete and epoxy must be cured before they come into contact with the water.
	Pesticides
72	Pesticides will be applied only under direct supervision (within line of sight) of a licensed applicator.
73	When native plants are being restored to a project site, pesticides can be used to control those weeds listed in the King County Noxious Weed List. Plants that are highly invasive and damaging to native riparian habitats include Himalayan Blackberry, clematis, morning glory, and Japanese knotweed.
74	Within the shoreline and riparian zone of all waterbodies, use only herbicide products containing glyphosate for general weed control and/or selected Washington State Department of Ecology-approved herbicides mandated for aquatic noxious weed control.

3.9 Method 9: Trench Support/Safety Systems

These systems are protective structures used to provide lateral support of excavations. They may consist of underpinning, bracing, shoring, or sheeting material. By preventing movement of excavated walls, support systems ensure worker safety and the integrity of a surrounding sensitive area such as a steep slope, wetland, stream or large waterbody. The following is the construction technique for these systems:

3. Protective systems will be restricted to trench safety systems when soils are competent or to engineered trench support systems when soils are not competent or are needed to protect adjacent facilities (i.e., pipelines, buildings or pavement). Native Soils shall be evaluated and typed prior to selecting the shoring system.
4. Shoring shall be installed as quickly as possible to avoid caving and to protect any nearby structures.
5. Low-impact trenchless construction alternatives may be used in lieu of open trenching and shoring when work is conducted in waterbodies. The use of benching and sloping will not be allowed. Protective system requirements are defined by WAC Chapter 296-155 part N. Available at:

   http://www.lni.wa.gov/wisha/rules/construction/HTML/296-155N_1.htm

   Requirements addressing contractor trench safety systems are defined by Washington Industrial Safety and Health Act (RCW Chapter 49.17).
6. Minimize trench width to neatline requirements, and depth to neatline dimensions as shown on the project drawings (Std Plan 284, 285 & 350, Std Specs 7-10.3(7) and 7-17.3(1)A).
7. Dewatering and groundwater recharge may be a necessary part of the protective system (see **Method 3**). The need for dewatering should be evaluated.
8. Over 20 feet deep of excavation, the excavation or trench will require a Shoring Plan stamped by a Professional Engineer.

Equipment Used

Backhoe/excavator, car, concrete mixer, concrete pump, dump truck, equipment for installing sheets and piling, front-end loader, large and small compactor, pick-up and flat-bed trucks, pump, tractor, trailer, trench box.

Conservation Measures • Approved work windows • Stormwater pollution prevention • Shoreline and aquatic habitat protection	
#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec (1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan. (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
17	Two oil absorbing floating booms appropriate for the size of the work shall be available onsite during all phases of work whenever heavy equipment is used below the OHW or MHHW. The booms shall be placed in a location that facilitates an immediate response to potential petroleum leakage.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Minimize site- preparation-related impacts
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.
21	Stockpile native streambed or substrate materials above the OHW for later use in project restoration. To prevent contamination from fine soils, these materials shall be kept separate from other stockpiled material not native to streambed or substrate.
	Minimize stream crossing sedimentation
25	Minimize stream and riparian crossings. If possible, cross at right angles to the main channel.
26	Where temporary stream crossings are essential, crossings shall be managed to minimize the risk of creating erosion.

	Temporary Dewatering Plan requirements
30	Develop a Temporary Dewatering Plan (TDP) for any dewatering lasting more than 1 day or requiring the installation of a trench safety system.
	Shoreline and Aquatic Habitat Protection
	All projects/ all structures
54	Perform the work in the dry whenever possible (80-90% of the time).
55	Minimize construction impacts by conducting work during minus tides or low water levels.

3.10 Method 10: Beach Nourishment and Substrate Addition

This method, also known as beach sand and gravel replacement, replenishes sand and/or gravel above and below the high waterline on City swimming or other beaches It is used to improve or to restore the function of designated swimming beaches and, in other locations, to provide improved substrate for aquatic organisms. It is also used as part of the work in replacing or installing stormwater or combined sewer outfalls.

A. Beach Nourishment

Work is typically done while the water level is low so that most of the beach area is exposed. Clean sand/gravel is hauled to the beach by truck and deposited at or above the water line at low tide. Occasionally, some material is deposited directly in the water. The deposited material is then spread by front-end loader, tractor, or backhoe. An alternative to in-water spreading is to allow the material to naturally distribute with the movement of the water.

Besides small amounts of sand/gravel that may be brought to the site by truck, in certain situations beach nourishment is best effected by delivering the sand or gravel by barge. This would be the case when truck access is not possible or when larger amounts of material are involved. In these cases, the material will be barged to the site and offloaded by front-end loader or conveyor system. Material is then spread at low tide or lower water by a track excavator situated on a barge. Wave action further flattens any undulations left by the excavator.

B. Substrate Addition

Soil can be added to the shoreline as part of the pipe or outfall replacement or installation in order to restore the bank to a more natural topography with area-similar-grain-sized soils. Stream gravel can be imported to disturbed sites to restore the stream bed. The gravel size distribution should be selected during the design phase based on consideration of the stream geomorphology and anticipated fish species likely to utilize the site.

When new channel substrate is specified, the material shall be from a clean source and shall be washed to remove fines. A gradation analysis and evaluation of scour as well as stability of new material to resist stream forces based on native substrate shall be used to properly size the channel substrate mix.

Habitat mix is a specific substrate to benefit macroinvertebrates and fill in interstitial space in larger-sized substrate.

Equipment Used

Backhoe, barge, front-end loader, rake, shovel, small dump truck, track excavator, tractor

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	General restoration in open waters
27	For in-water work at or below OHW or MHHW, appropriate and effective erosion or other water quality control devices will be in place before project work begins. Control devices include sealed sand or gravel bags, silt curtains, silt fencing, or other containment systems. Deploy and maintain curtain at sufficient depth to reach bottom and contain sediment.
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
54	Perform the work in the dry whenever possible (80-90% of the time).
55	Minimize construction impacts by conducting work during minus tides or low water levels.
56	All fill materials will be of clean, washed, commercially-obtained material.
59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
	Beach nourishment/substrate addition
63	Beach material will typically be washed gravel whenever possible to minimize the amount of fill eroding into the waterbody. Sands may be applied above the OHW or MHHW depending on project purpose.

3.11 Method 11: Boat Launch Improvement, Repair and Maintenance

Boat ramp repair/maintenance is the resurfacing and restoration of material used to facilitate the public launching of boats from trailers. Efficient boat launching requires maintained parking and circulation areas as well as driving surfaces and armoring leading into the water. Repair and maintenance work at boat launches typically includes filling prop wash holes; replacement of ballast, edge armoring, and/or concrete panels; and repair of holes/broken edges on concrete panels. This method includes the following routine activities:

- Filling prop wash holes
- Replacing ballasts, edge armoring and concrete panels.

A. Fill Prop Wash Holes

This method allows for the return or replacement of substrate to holes created by prop wash. If the displaced material remains in a mound in the vicinity of the hole, it is simply returned to the wash hole (gravel return method). Otherwise, the hole is filled with imported gravel (gravel replacement method).

Gravel Return Method

Whenever practicable, hand tools and a bucket are used to scoop, return, and spread the displaced gravel back into the hole. At some locations, a backhoe or similar equipment may be required for this work. If heavy equipment is used, only the extension arm and bucket enter the wetted perimeter.

Gravel Replacement Method

Clean gravel is hauled to the boat ramp on existing roads and dumped above the water line. The rock is placed and spread by hand tools into the prop wash hole whenever practicable. If heavy equipment is used for placing and spreading the gravel, only the extension arm and bucket enter the wetted perimeter. Up to 30 cubic yards of gravel may be required to fill holes. Clean, washed, crushed gravel is used. The diameter of the gravel particles is typically 1 to 4 inches, depending on the depth of the prop wash holes.

Equipment Used

Backhoe, bucket, hand shovel, small dump truck, tractor

B. Replace Ballast, Edge Armoring and Concrete Panels; Repair Concrete Panels

This method allows for the replacement of pre-cast concrete panels, associated ballast, and edge armoring at boat launches. In addition, this method allows for the repair of concrete launch panels, such as patching a crack/hole or replacing a broken corner. Most of this work (80-90%) can be done in the dry and is timed to coincide with low water levels at the project site. Of necessity, all cast-in place work must be done in the dry.

Replacing Ballast, Edge Armoring, Concrete Panels

Whenever practicable, hand tools and a bucket are used to scoop, return, and spread displaced gravel back into the hole. At some locations, a backhoe or similar equipment may be required for this work. If heavy equipment is used, only the extension arm and bucket enter the wetted perimeter.

Replacing Cast-in-place Concrete Panels

For cast-in place concrete panels, the deteriorated panels of the ramp are demolished and a ballast placed and leveled. Temporary wood frames are placed along the edges of the ramp to delineate the footprint and rebar or metal wire fabric is secured with anchor bolts. High-early-strength concrete formulated specifically for pouring directly in water is used. An anti-washout admixture is used to greatly reduce or eliminate concrete washout during curing. These additives produce concrete that becomes fluid when sheared or mechanically agitated but reverts to dense, high viscous consistency when at rest. The mixtures reduce or eliminate the accumulation of fine particles on the surface of curing concrete. This type of concrete sets almost immediately. A tremie (tube) is used, which allows the concrete truck to remain as far as possible from water's edge. Pouring begins shortly after tidal water recedes on Puget Sound locations, so that maximum hardening time is available before inundation. During hardening, the cast-in-place concrete is covered with plastic to minimize the surface area that contacts with water.

Repairing Concrete Panels

Some repairs to a concrete boat launch can be undertaken if panel replacement is cost prohibitive. To replace an edge or corner piece that has broken off, the broken edge is smoothed or cleaned with a power wash, steel bars are embedded in the panel (if the original bars are damaged or destroyed), a sealed form is attached, and the form is filled with fast-curing concrete. Generally, the form is left in place and protected from use by boaters for 1 to 2 days while the concrete gains strength. To fill a thin crack, a quick-setting, high-strength grout (e.g., Portland cement) is used. For larger holes, a concrete saw or chisel is used to prepare the hole prior to filling with fast curing concrete.

Equipment Used

Backhoe, concrete mixer, concrete pump, crane, dump truck, excavator, front-end loader, hand shovel, power wash, tractor, wheelbarrow

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec 1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	General restoration in open waters
28	If mechanized equipment is used with the OHW or MHHW, only an extension arm with bucket or similar attachment shall enter the water. Conduct debris removal and work below OHW or MHHW during low water levels (fresh waters) or at low tide (marine waters). This prevents material from entering the water during construction. All debris removed shall be disposed of offsite in an approved upland disposal area.
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
54	Perform the work in the dry whenever possible (80 – 90% of the time).
55	Minimize construction impacts by conducting work during minus tides or low water levels.
56	All fill materials will be of clean, washed, and commercially-obtained material.

60	Take care to prevent spread of invasive plant species during their removal.

	Boat launch
66	No wet concrete or epoxy shall be placed in the wetted perimeter. Concrete and epoxy must be cured before they come into contact with water.

3.12 Method 12: In-water/Overwater Structure Repair and Replacement

Several types of fixed and floating recreational structures are found in and above open waters and wetlands at City of Seattle parks. Fixed structures are those having a permanent horizontal and vertical alignment and include piers, viewing platforms, pedestrian bridges and abutment wing walls. The in-water vertical support for these fixed structures is typically piling of, timber, steel, or concrete but can be rubble or rock. Floating structures include connecting ramps, floats, floating breakwaters, floating log booms, buoys and rafts. Periodically, these structures require either repair or replacement. This method includes repairing and replacing the following:

- Piling
- Anchor and chain systems
- Superstructure decking, and utilities on fixed structures
- Floats and gangways
- Floating logbooms
- Buoys
- Fixed breakwaters.

A. Piling

The following 3 methods are typically used to replace piling:

- Full extraction of an existing pile and driving a new pile
- Cutting off the existing pile below the mudline and driving a new pile
- Driving a new pile.

Fully Extracting an Existing Pile and Driving a New Pile

1. For full extraction, the pile is removed either by use of a choker chain and crane or with a vibratory pile driver.
2. For the choker chain method, the chain is placed securely around the pile. Then by using a crane mounted on a barge, the crane operator pulls the pile directly up until it is completely out of the substrate.
3. For the vibratory method, the vibratory pile driver is mounted on a barge and the vibratory hammer is clamped onto the top of the pile. The vibration of the pile driver loosens the pile from the substrate. The vibratory hammer is raised directly upward as the pile loosens until the pile is completely free from the substrate.

The vibratory method is the preferred method, especially when the pile is firmly secured in the substrate. There is less likelihood for the pile to break.

Once removed, the pile is placed on the barge and disposed of at an appropriate upland location (disposal depends on chemical treatment of piling). Upon removal of the piling, new or recycled (non-creosote) piling is driven. The method for driving a new pile is described below.

Cutting Off the Existing Pile below the Mudline and Driving a New Pile

A pile is cut off below the mudline when it is so deteriorated or rotted that it would break during extraction. If the pile inadvertently breaks during extraction, it is also cut off below the mudline and broken portions of the pile are removed from the water column. The piling is cut by a diver underwater using a pneumatic saw or knife. Depending on the height of the piling, they may be cut in sections. The pneumatic knife technique cuts the pile below the mudline without dredge material removal. The pneumatic saw is used once the area around the pile is excavated with a clamshell or hydraulic dredge. The dredged material and cut piling are placed, secured, and contained on the barge and disposed of at a Washington State Department of Ecology-approved upland disposal site.

Where a piling is pulled, the hole is backfilled with clean sand to match the surrounding substrate. Caps are placed on piling only in situations were piling are retained for future use.

If the pile being removed is treated wood (e.g., creosote), the area is capped to ensure that chemicals do not leach into the adjacent substrate and water column. Capping material depends on the substrate, current conditions, and boat activity (potential for propwash) at the site. The same equipment used to excavate around the pile is typically used to place the capping material: a clamshell dredge or tremie. Appropriate capping includes, but is not limited to, clean/washed sand, habitat mix, or a hard plastic or steel cap placed directly on the cut pile. Adjacent material may be used unless it is contaminated. Upon removal of the piling, new or recycled piling is driven. New pile driving is described below.

Driving a New Pile

When the piling is removed, new or recycled piling are driven using a barge-mounted pneumatic pile driver, standard drop-hammer, or vibratory pile driver. A pile is lowered through the piling-guide until it rests in place on the substrate and is then driven to an adequate depth. Should refusal come at an insufficient depth, the pile is pulled and moved to gain more depth. Setup time for each piling is generally 20 to 30 minutes while actual driving time is about the same, depending on tide and substrate conditions. Pneumatic pile drivers are most common today, but the older pile drivers that use a heavy weight dropped on top of the pile are still used. The weight drop technique is used when bearing capacity is geotechnically and structurally required.

Equipment Used

Barge, containment boom, crane, excavation bucket, hydraulic dredge, piling and lagging, sheet driving, tremie

Conservation Measures

- Approved work windows
- Overwater structure size
- Piling installation and noise abatement
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Overwater Structure Size
	Floats, docks or piers
34	Minimize/reduce piling number and space piling further apart where possible to reduce shading impacts.
	Piling Installation and Noise Abatement
	Installation
43	Plastic, cement or timber piling is preferred over steel piling.
44	Use a containment boom for sawdust and debris work. If in marine water, a containment boom may rest on substrate rather than float at all times due to tidal action. Remove contained debris to prevent it from entering the waterway at construction completion.
45	If treated piling are fully extracted or cut below the mudline, cap the holes or piling with appropriate materials (e.g., clean sand or steel pile caps for cut piling). This practice ensures that chemicals from the existing piling do not leach into the adjacent sediments or water column.
46	Do **not** use piling treated with creosote or pentachloraphenol.
47	Do **not** use hydraulic water jets to remove or place piling.
48	Replace piling in same general location. Do **not** extend beyond footprint of existing structure.
	Noise abatement
49	Use a vibratory driver to the extent possible for setting pile. Geotechnical engineering can determine if this will be sufficient based on the piling material and load capacity.
50	A bubble curtain or other noise attenuation method (wood blocks, nylon blocks etc.) shall be used during impact installation or proofing of steel piling. For piling with a 10-inch or smaller diameter, the sound attenuation device must include one of the methods listed above. For piling with a diameter greater than 10 inches, the sound attenuation device must include both the placement of a sound block between the hammer and the piling during pile driving **and** use of a bubble curtain.

51	Hydroacoustic monitoring shall be used for driving large (> 12-inch diameter) steel piling.
52	All reasonable measures shall be taken for the suppression of noise resulting from the work operations. All work shall be performed consistent with the applicable noise control levels set forth in SMC Chapter 25.08.
53	Projects using an impact hammer to drive or proof steel piling in marine/estuarine waters must deploy sound attenuation **and** have an observer onsite during all pile driving and proofing to scan open water within a certain radius around the work area (see Table 4-9 in Chapter 4). If a marine mammal is observed within radius, all pile driving must stop.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

B. Anchor and Chain Systems

Anchor and chain systems are typically used as the lateral support for floats and mooring buoys. Both concrete and metal anchors are used. The anchor is attached to the float or buoy by chain, cable, rope or similar material. A midline float is attached to the chain to prevent it from dragging on the substrate when water levels are low. Concrete anchors are dropped in place from a work boat. Helical metal anchors are placed by divers. Periodically the anchor system is inspected by a diver and, if necessary, the anchor, chain, and/or hardware are replaced.

Equipment Used

Hand tools, work boat

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Overwater structure size
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.

	Stormwater Pollution Prevention
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
	General restoration in open waters
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Overwater structure size
	Anchoring buoys, floats and floating breakwaters
41	Ensure that anchor lines do not drag on the substrate or in aquatic vegetation during low water levels. Buoy cables or chains will be kept off of the bottom by the addition of a second float below the surface at the appropriate length and size to perform during all tidal and wind conditions.
42	Use mechanical anchors (e.g., helical screw) in lieu of concrete anchors unless substrate (e.g., bedrock) prevents installation of screw anchors.
	Shoreline and aquatic habitat
59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

C. Superstructure, Decking and Utilities on Fixed Structures

This method covers piers, viewing platforms and pedestrian bridges. These elements provide controlled access to sensitive environments. Foot traffic is contained on platforms and bridges to reduce impacts to wetlands, shorelines and riparian areas. As the materials deteriorate over time, they require replacement in kind, or to meet current standards.

Fixed Piers

Before construction, a containment boom is deployed to capture construction debris. Typical maintenance includes replacement of broken deck planks, hand rails, and utility lines.

Piling is cut to the desired length from a work barge using a chain saw, concrete saw, oxyacetylene torch, or similar tool. Rails and stringers are attached to the piling using power tools, galvanized hardware, and epoxy. Waterproof conduits (galvanized steel or waterproof conduits) are attached to the rails and stringers for electricity and water

service. If grating is installed, a frame is built on the stringers and rails before placing the grated panel. Decking wood or composite material (e.g., Ironwood, Trex) is laid, screwed into place, and excess ends are cut off with a saw. Hand rails are attached if required.

Viewing Platforms

Viewing platforms are structures that can be built onshore or extend over a waterbody from the shoreline. They are constructed either with in-water support piling, or with beams cantilevered from the shoreline. The superstructure, decking, and utilities are constructed in generally the same manner as described for fixed piers.

Pedestrian Bridges

Pedestrian bridges span an open water or wetland. They are constructed with either in-water or upland supporting structures. End supports are typically piling, micro piling, or pin piling with wood lagging, modular blocks, and/or gravity concrete abutments. The end supports are constructed before the bridge modular sections are brought to the site. Sections are generally brought in by hand over a foot trail and are swung into place by site-installed rigging. Micro piling and/or pin piling are driven with a pneumatic hammer (usually 90 lb) until the desired depth or bearing is reached. The narrow pipes for pin piling are driven to a maximum of about 15 feet. Pin piling range up to about 4 inches in diameter and micro piling up to 8 inches in diameter. Most pin piling includes a cored pre-formed concrete base. The concrete base pad is placed above the water line and is used to connect the bridge elements to the bridge bearing surface. The piling is driven through the preformed concrete ‘pads’ at predetermined holes set by the manufacturer.

Scour Walls, Footings and Abutments for Pedestrian Bridges

Pedestrian bridges are placed on shot rock, rubble, pile with lagging, and/or concrete. Where slope gradients and slope stability allow, the bridge base structures are built above the MHHW or OHW. When site conditions require in-water work, hand placement is explored first as a design criteria. When hand placement of materials is not feasible for worker safety, entry into the water with small equipment (e.g., track hoe, front-end loader) is used to move materials. All placed material is washed before it is placed.

Equipment Used

Backhoe, barge, containment boom, crane, cutting torch, front-end loader, jack hammer, power tools (saws, drills), track hoe, work boat

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Overwater structure size
- Piling installation and noise abatement
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall be required to have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5) .
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Minimize site preparation-related impacts
7	Limit clearing and grubbing area to minimum required. Retain vegetation to maximum extent possible. Minimize clearing and grubbing effects by cutting vegetative stems but not removing the root systems, which help to reduce erosion potential and allow native plants to regenerate.
12	Place sediment barriers (silt fences, coir logs, wood straw, or other effective erosion control method) around disturbed sites to prevent erosion from sediment entering a waterbody.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Minimize earth-moving-related erosion
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.

	Minimize stream crossing sedimentation
25	Minimize stream and riparian crossings. If possible, cross at right angles to the main channel.
26	Where temporary stream crossings are essential, crossings shall be managed to minimize the risk of creating erosion.
	General restoration in open waters
27	For in-water work at or below OHW or MHHW, appropriate and effective erosion or other water quality control devices will be in place before project work begins. Control devices include sealed sand or gravel bags, silt curtains, silt fencing, other containment systems. Deploy and maintain curtain at sufficient depth to reach bottom and contain sediment.
28	If mechanized equipment is used within the OHW or MHHW, only an extension arm with bucket or similar attachment shall enter the water. Conduct debris removal and work below OHW or MHHW during low water levels (fresh waters) or at low tide (marine waters). This prevents material from entering the water during construction. All debris removed will be disposed of offsite or to an approved upland disposal area.
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Overwater Structure Size
	Floats, docks or piers
33	Overwater structures such as piers and floats should be no larger (length and width) than needed for the specified function (see Table 4-8). Minimize/reduce pier and overall footprint of structure to reduce shading impacts. In the SPIF, give rationale for project-specific pier and float size requirements.
35	To reduce shading impacts, grating shall be installed on fixed structure surfaces during replacement to provide light transmission to the maximum extent practicable and American Disabilities Act (ADA) requirements. If grating cannot be installed in pier/float decking, consider using transparent glass blocks, prisms, or floors to obtain more light under pier.
37	In marine waters, replacement floats shall be at least 4 feet above marine vegetation (*e.g.,* eelgrass) to avoid creating new shade over marine vegetation.
38	Place new and replacement piers at least 2 feet above OHW or MHHW.
	Piling Installation and Noise Abatement
	Installation
43	Plastic, cement or timber piling is preferred over steel piling.
44	Use a containment boom for sawdust and debris work. If in marine water, a containment boom may rest on substrate rather than float at all times due to tidal action. Remove contained debris to prevent it from entering the waterway at construction completion.
46	Do **not** use piling treated with creosote or pentachloraphenol.
	Noise abatement
52	All reasonable measures shall be taken for the suppression of noise resulting from the work operations. All work shall be performed consistent with the applicable noise control levels set forth in SMC Chapter 25.08.
	Shoreline and Aquatic Habitat Protection
	All project/all structures
54	Perform the work in the dry whenever possible (80 – 90% of the time).
55	Minimize construction impacts by conducting work during minus tides or low water levels.

56	All fill materials will be of clean, washed, and commercially-obtained material.

59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
60	Take care to prevent spread of invasive plant species during their removal.
61	Plant the project shoreline with native riparian vegetation. City crew/contractor will ensure 80% survival of the planted material at 1, 3, and 5 years after installation. Riparian planting plans will be submitted along with the project permit application.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

D. Floats and Gangways

Floats and gangways are fabricated at land-based facilities and transported to the site by barge, work boat, or truck. A crane or similar hoisting machine is used to lift and locate the float or gangway into position and/or a small boat is used for final location and connection. Float designs include in-water lateral support, flotation, superstructure, and decking. In-water lateral support is typically by piling or anchor and chain system. The construction method, equipment, and conservation measures for piling and chain and anchor systems are described above in *section B, Anchor and Chain Systems*. Rings, hoops, blocked pockets or similarly designed hardware is used to connect floats to piling or anchors. For the chain and anchor system, concrete or metal anchors are attached to the float by a galvanized steel chain or similar material. Floats are generally pulled from the water by mechanical means and repaired on dry land. See Table 4-8 in **Section 4, Conservation Measures**.

Equipment Used

Barge, crane, power or hand tools, work boat

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Overwater structure size
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.

	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec 1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan. (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Minimize site-preparation-related impacts
6	Establish staging and site access areas along existing roadways or other disturbed areas to minimize erosion into or contamination of sensitive areas or their buffers. Confine work to the area noted using flagging or other barriers.
7	Limit clearing and grubbing area to minimum required. Retain vegetation to maximum extent possible. Minimize clearing and grubbing effects by cutting vegetative stems but not removing the root systems, which help to reduce erosion potential and allow native plants to regenerate.
9	Ensure proper BMPs, such as covering, berming, matting, seeding or mulching are implemented to prevent erosion of any excavated material.
12	Place sediment barriers (e.g., silt fences, coir logs, wood straw or other effective erosion control method) around disturbed sites to prevent erosion from sediment from entering a waterbody.
13	Keep a supply of erosion control materials (e.g., silt fence or mulch) on hand to respond to sediment emergencies. For wetland areas with high likelihood of germination, use wood straw.
14	Use curb inlet sediment traps and geotextile filters, along with silt fencing, to capture sediment before it leaves the site.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
17	Two oil absorbing floating booms appropriate for the size of the work shall be available onsite during all phases of construction whenever heavy equipment is used below the OHW or MHHW. Place booms in a location that facilitates an immediate response to potential petroleum leakage.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.

	Minimize stream crossing sedimentation
25	Minimize stream and riparian crossings. If possible, cross at right angles to the main channel.
26	Where temporary stream crossings are essential, crossings shall be managed to minimize the risk of creating erosion.
	General restoration in open waters
27	For in-water work at or below OHW or MHHW, appropriate and effective erosion or other water quality control devices will be in place before project work begins. Control devices include sealed sand or gravel bags, silt curtains, silt fencing, other containment systems. Deploy and maintain curtain at sufficient depth to reach bottom and contain sediment.
28	If mechanized equipment is used within the OHW or MHHW, only an extension arm with bucket or similar attachment shall enter the water. Conduct debris removal and work below OHW or MHHW during low water levels (fresh waters) or at low tide (marine waters). This prevents material from entering the water during construction. All debris removed will be disposed of offsite or to an approved upland disposal area.
29	Confine use of equipment operating below OHW or MHHW to designated access corridors.
	Overwater Structure Size
	Floats, docks or piers
33	Overwater structures such as piers and floats should be no larger (length and width) than needed for the specified function (see Table 4-8). Minimize/reduce pier and overall footprint of structure to reduce shading impacts. In the SPIF, give rationale for project-specific pier and float size requirements.
35	To reduce shading impacts, grating shall be installed on fixed structure surfaces during replacement to provide light transmission to the maximum extent practicable and American Disabilities Act (ADA) requirements. If grating cannot be installed in pier/float decking, consider using transparent glass blocks, prisms, or floors to obtain more light under pier.
36	Flotation for floats will be fully contained in a durable protective casing to prevent breakup of the flotation material and its release into the waterway.
37	In marine waters, replacement floats shall be at least 4 feet above marine vegetation (e.g., eelgrass) to avoid creating new shade over marine vegetation.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
60	Take care to prevent spread of invasive plant species during their removal.
61	Plant the project shoreline with native riparian vegetation. City crew/contractor will ensure 80% survival of the planted material at 1, 3, and 5 years after installation. Riparian planting plans will be submitted along with the project permit application.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

E. Floating Log Boom

A floating log boom is a chained or cabled series of floating timbers that serves to obstruct navigation. The in-water support for these structures is typically piling and/or anchor and chain system. The construction method, equipment, and conservation measures for piling and for anchor and chain systems are described above in section *12B,*

Anchor and Chain Systems. Log booms are fabricated at a land-based facility before delivery to the site by barge, work boat, or truck. If necessary, a crane or similar hoisting machine lifts the boom or breakwater into place and it is attached to the piling or chain and anchor system. Otherwise, the boom is floated as a raft to the site, extended open, and attached to the support piling or chain and anchor system.

Equipment Used

Barge, crane, delivery truck, hand tools, work boat

Conservation Measures

- Approved work windows
- Overwater structure size
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Overwater Structure Size
	Floats, docks and piers
39	Limit overall size, length, and width to minimum necessary for wave attenuation and safe public use/navigation.
	Anchoring buoys and floating breakwaters
41	Ensure that the anchor lines do not drag on the substrate or in aquatic vegetation during low water levels. Buoy cables or chains will be kept off of the bottom by the addition of a second float below the surface at the appropriate length and size to perform during all tidal and wind conditions.
42	Use mechanical anchors (e.g. helical screw) in lieu of concrete anchors unless substrate (e.g., bedrock) prevents installation of screw anchors.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

F. Buoys

A buoy is a floating object used to moor boats, aid navigation, or mark an area. The size of the buoy depends on its purpose. Buoys may be set individually or attached together in a linear system.

Individual Buoys

The in-water vertical support is typically an anchor and chain system.

Attached Line of Buoys

The vertical support may be piling or an anchor and chain system. The construction method, equipment, and conservation methods for piling and for anchor and chain systems are described above in sections **12A, Piling** and **12B, Anchor and Chain Systems**. The buoy typically has a foam core, durable outer surface, a rod through its diameter, and eye bolts attached to the rod ends. Periodically buoys, anchors, chains, and their hardware are inspected by divers and, if necessary, replaced or repaired.

Equipment Used

Hand tools, work boat

Conservation Measures

- Approved work windows
- Overwater structure size
- Shoreline and aquatic habitat protection

	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Overwater Structure Size
	Anchoring buoys and floating breakwaters
41	Ensure that the anchor lines do not drag on the substrate or in aquatic vegetation during low water levels. Buoy cables or chains will be kept off of the bottom by the addition of a second float below the surface at the appropriate length and size to perform during all tidal and wind conditions.
42	Use mechanical anchors (e.g., helical screw) in lieu of concrete anchors unless substrate (e.g., bedrock) prevents installation of screw anchors.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
59	If a construction barge is used, it shall not ground or rest on the substrate at anytime or anchor over vegetated shallows.
60	Take care to prevent spread of invasive plant species during their removal.

61	Plant the project shoreline with native riparian vegetation. City crew/contractor will ensure 80% survival of the planted material at 1, 3, and 5 years after installation. Riparian planting plans will be submitted along with the project permit application.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

G. Fixed Breakwaters

Breakwaters are structures that provide protection against wave actions and are used on their protected side for boat moorage or swimming. Pile breakwaters with lagging and/or revetments are constructed from land-based equipment and hand tools. The breakwaters are made from a combination of materials such as timber in the splash zone and revetment rock in the shoal area with concrete walks or access points. Damage to wood lagging is repaired with hand equipment. Revetment lost to shore drift and/or prop scour is replaced by hand.

Equipment Used

Backhoe, hand tools (maintenance only), piling and lagging, work boat

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec 1.07.15, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan. (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall be required to have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.

	Minimize site-preparation-related impacts
6	Establish staging and site access areas along existing roadways or other disturbed areas to minimize erosion into or contamination of sensitive areas or their buffers. Confine work to the area noted using flagging or other barriers.
12	Place sediment barriers (e.g., silt fences, coir logs, wood straw or other effective erosion control method) around disturbed sites to prevent erosion from sediment from entering a waterbody.
13	Keep a supply of erosion control materials (e.g., silt fence or mulch) on hand to respond to sediment emergencies. For wetland areas with high likelihood of germination, use wood straw.
14	Use curb inlet sediment traps and geotextile filters, along with silt fencing, to capture sediment before it leaves the site.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
17	Two oil absorbing floating booms appropriate for the size of the work shall be available onsite during all phases of construction whenever heavy equipment is used below the OHW or MHHW. The booms shall be placed in a location that facilitates an immediate response to potential petroleum leakage.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Minimize earthmoving-related erosion
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.
20	Use temporary materials such as geotextile barriers, hog fuel or wood pellets to stabilize haul and access routes, staging areas and stockpile areas.
	General restoration in open waters
27	For in-water work at or below OHW or MHHW, appropriate and effective erosion or other water quality control devices will be in place before project work begins. Control devices include sealed sand or gravel bags, silt curtains, silt fencing, other containment systems. Deploy and maintain curtain at sufficient depth to reach bottom and contain sediment.
28	If mechanized equipment is used within the OHW or MHHW, only an extension arm with bucket or similar attachment shall enter the water. Conduct debris removal and work below OHW or MHHW during low water levels (fresh waters) or at low tide (marine waters). This prevents material from entering the water during construction. All debris removed will be disposed of offsite or to an approved upland disposal area.
	Overwater Structure Size
	Floating breakwaters
40	Logs shall be clean and without bark.
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
54	Perform the work in the dry whenever possible (80 – 90% of the time).
55	Minimize construction impacts by conducting work during minus tides or low water levels.

56	All fill materials will be of clean, washed, and commercially-obtained material.

60	Take care to prevent spread of invasive plant species during their removal.
61	Plant the project shoreline with native riparian vegetation. City crew/contractor will ensure 80% survival of the planted material at 1, 3, and 5 years after installation. Riparian planting plans will be submitted along with the project permit application.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.
	Beach nourishment/substrate addition
64	Use clean gravel (less than 3% fines by weight [material passing a number 200 sieve per U.S. standard sieve size]) to avoid turbidity during gravel placement.
	Riprap addition
70	When installing riprap, include rootwads and/or large woody material to increase habitat complexity
71	Cover all newly placed riprap with habitat mix to fill voids and cover the rock to benefit benthic organisms. In location where habitat mix will wash away rapidly, it may be deemed unnecessary to install.

3.13 Method 13: Site Restoration

Site restoration stabilizes the site after construction is complete, the staging and access areas are vacated, and Temporary Erosion and Sediment Control (TESC) measures are modified to ensure effective stabilization. These measures prepare the site for replanting, return to pre-construction use, and protect disturbed soil from erosion and invasive weeds.

Inspect rough grading to ensure final slopes will not generate erosive energy affecting sensitive areas. When necessary, loosen compacted access roads, staging, and stockpile areas (Std Spec 2-03.3(15) and TESC measures. Scatter and place stockpiled woody debris.

Upon project completion, spread or remove stockpiled materials. All imported soil or rock must be removed, and the covered surface regraded and replanted to original conditions at project completion (Std Specs 2-12 and 8-02).

If final site restoration activities cannot be completed within **5 days** of the last construction phase, install interim measures (erosion control) until conditions permit installation of the restoration plan (Std Specs 1 08.6, 1-08.7, and 8-01).

Equipment Used

Cars, chain saw, dump truck, front-end loader, hand tools, pick-up truck, spray equipment, tractor, trailer, weed trimmer, wheelbarrow

Conservation Measures

- Approved work windows
- Stormwater pollution prevention
- Piling installation and noise abatement
- Shoreline and aquatic habitat protection

#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.

	Minimize site preparation-related impacts
11	Salvaged debris such as roots and stumps may be used for habitat. Disposal of debris may include chipping, shredding, or grinding for reintroduction to the site as mulch (Std Specs 1-05.13(3), 1-07.5, 2-01.2, 2-10.3(2) and 8-01).
12	Place sediment barriers (e.g., silt fences, coir logs, wood straw or other effective erosion control method) around disturbed sites to prevent erosion from sediment from entering a waterbody.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters area typically covered with water.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Minimize earthmoving-related erosion
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.
24	Remove equipment and excess supplies, clean work storage areas, and remove temporary erosion control materials and temporary fill after construction when soils have stabilized. (Std Spec 104.11)
	Shoreline and Aquatic Habitat Protection
	All projects/all structures
54	Perform the work in the dry whenever possible (80 – 90% of the time).
55	Minimize construction impacts by conducting work during minus tides or low water levels.
62	Require contractor to retrieve any debris generated during construction that has entered the water and sunk to dispose of it at an upland facility.

3.14 Method 14: Landscaping and Planting

This method creates new or repairs existing landscapes after sensitive area disturbance. New native plantings may be installed to replace lawns, high maintenance landscapes, or impervious surfaces. Success will be measured with percent survival, site cover, invasive plant cover or target species diversity monitoring. Replanting of native plant communities increases wildlife and fish habitat. Before spreading topsoil, check stockpile for weed contamination or soil compaction due to settling during storage. Check subgrade for proper compaction, particularly over trenches. If soil is added, till to the specified depth at the specified ratio. Avoid overcompaction and ensure even distribution of topsoil.

No fertilizers are used to establish restoration. Soil amendments are allowed if approved for riparian application.

Install specified native plants. Typically planting does not occur until late October to January to ensure greater success and reduce initial watering requirements. Add mulch to the site to suppress weeds and enhance soil moisture. Schedule the monitoring and maintenance program according to the planting plan and permit requirements. Maintenance may be required for up to 5 years (Std Specs 2-03.3(14) and (15), and 8 02).

'Pesticide' is a generic term for any licensed or registered product or material including herbicides, insecticides, and fungicides, or biological agents applied to a target pest as control measure**.** Pesticide use, when necessary, is part of an Integrated Pest Management (IPM) approach. Permits are required from the departments of Ecology and Agriculture if a pesticide (i.e., herbicide) is used to control invasive/noxious aquatic weeds.

City of Seattle departmental IPM coordinators approve specific pesticide applications. The Office of Sustainability and Environment approves certain chemicals such as a Tier 1 Exemption.

Equipment Used

Backhoe/excavator, bull dozer, cars, dump truck, front-end loader, hand tools/wheel barrow, hydro-seeding truck, pick-up truck, tiller, trailer, watering truck for irrigation during plant establishment

Conservation Measures • Approved work windows • Stormwater pollution prevention • Shoreline and aquatic habitat protection • Pesticides	
#	
	Approved Work Windows
1	All work shall comply with the approved work windows/timing restrictions for the protection of ESA-listed species or species they forage upon in the Seattle action areas.
	Stormwater Pollution Prevention
	Develop TESC plan
2	Each project shall have onsite a written Temporary Erosion and Sedimentation Control (TESC) plan that includes all information needed to reduce erosion and sedimentation on the project (Std Spec 1.07.`5, 8-01). All projects will require the contractor to assign an onsite Erosion Control Lead to oversee the work and ensure compliance with the TESC plan (Std Spec 1-05.13(3).
	Ensure City crew/contractor has SPCP
3	The City crew/contractor shall have onsite a written Spill Prevention and Control Plan (SPCP) that describes materials to be used and measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc) (Std Spec 1-07.5(5).
4	Maintain a spill kit onsite to respond to accidental spills during construction. Ensure that spill kit is stocked with adequate containment material and other supplies to suit the specific job site and potential containment distances.
	Minimize site-preparation-related impacts
5	Confine construction impacts to the minimum area necessary to complete the project and delineate impact areas on project plans. Flag boundaries of clearing limits associated with site access, construction, and staging areas as well as wetland and riparian corridor where work has been authorized.
6	Establish staging and site access areas along existing roadways or other disturbed areas to minimize erosion into or contamination of sensitive areas or their buffers. Confine work to the area noted using flagging or other barriers.
7	Limit clearing and grubbing area to minimum required. Retain vegetation to maximum extent possible. Minimize clearing and grubbing effects by cutting vegetative stems but not removing the root systems, which help to reduce erosion potential and allow native plants to regenerate.
9	Ensure proper BMPs, such as covering, berming, matting, seeding, or mulching are implemented to prevent erosion of any excavated material.
10	Stockpile large wood, trees, riparian vegetation, other vegetation, sand, and topsoil removed for establishment of staging area and reuse for site restoration.
11	Salvaged debris such as roots and stumps may be used for habitat. Disposal of debris may include chipping, shredding, or grinding for reintroduction to the site as mulch (Std Specs 1-05.13(3), 1-07.5, 2-01.2, 2-10.3(2) and 8-01).
12	Place sediment barriers (e.g., silt fences, coir logs, wood straw or other effective erosion control method) around disturbed sites to prevent erosion from sediment from entering a waterbody.
13	Keep a supply of erosion control materials (e.g., silt fence or mulch) on hand to respond to sediment emergencies. For wetland areas with high likelihood of germination, use wood straw.

14	Use curb inlet sediment traps and geotextile filters, along with silt fencing, to capture sediment before it leaves the site.
	Avoid heavy equipment fuel/oil leakage
15	Equipment used for work below the OHW or MHHW or in riparian zones or shoreline areas shall be cleaned of accumulated grease, oil, mud, etc. and leaks repaired before arriving at the project.
16	Equipment shall be fueled and serviced in an established staging area. Thereafter, all equipment shall be inspected daily for leaks or accumulation of grease, and any identified problems fixed before equipment enters areas typically covered with water.
18	Vegetable-based hydraulic fluid should be substituted when machines will operate in sensitive areas or their buffer for more than incidental work.
	Minimize earthmoving-related erosion
19	Operate machinery from existing roads and paved areas where they exist in proximity to the site. In many cases, wood chippings and timber mats can provide a temporary surface where heavy equipment can access a work site.
20	Use temporary materials such as geotextile barriers, hog fuel or wood pellets to stabilize haul and access routes, staging areas and stockpile areas.
22	If equipment wash areas are required, they shall be located where washwater, sediment, and pollutants cannot enter waterbodies, including wetlands.
	Minimize stream crossing sedimentation
25	Minimize stream and riparian crossings. If possible, cross at right angles to the main channel.
26	Where temporary stream crossings are essential, crossings shall be managed to minimize the risk of creating erosion.
	Shoreline and Aquatic Habitat Protection
54	Perform the work in the dry whenever possible (80 – 90% of the time).
60	Take care to prevent spread of invasive plant species during their removal.
61	Plant the project shoreline with native riparian vegetation. City crew/contractor will ensure 80% survival of the planted material at 1, 3, and 5 years after installation. Riparian planting plans will be submitted along with the project permit application.
62	Require City crew/contractor to retrieve any debris generated during construction that has entered water and sunk to dispose of it at an upland facility.
	Beach nourishment/substrate addition
64	Use clean gravel (less than 3% fines by weight [material passing a number 200 sieve per U.S. standard sieve size]) to avoid turbidity during gravel placement.
	Bulkhead repair/replacement
69	Plant new bulkhead with native riparian vegetation where not in direct conflict with recreational use.
	Riprap addition
70	When installing riprap, include rootwads and/or large woody material to increase habitat complexity
71	Cover all newly placed riprap with habitat mix to fill voids and cover the rock to benefit benthic organisms. In location where habitat mix will wash away rapidly, it may be deemed unnecessary to install.

	Pesticides
72	Pesticides will be applied only under direct supervision (within line of sight) of a licensed applicator.
73	When native plants are being restored to a project site, pesticides can be used to control those weeds listed in the King County Noxious Weed List. Plants that are highly invasive and damaging to native riparian habitats include Himalayan blackberry, clematis, morning glory, and Japanese knotweed.
75	Other chemicals, such as foaming agents used to kill roots growing into utility pipes, will be subject to Tier 1 chemical application exemptions that will require approval from the Parks IPM coordinator **and** the Office of Sustainability and Environment.